THE MODEL ENGINEER

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Smoke Rings

A Lecture on Models

THE many applications of models to the solution of engineering problems were described at length in a lecture recently given by Mr. Robert A. Harvey, B.Sc., A.M.I.E.E., to the Salford Technical and Engineering Association. Mr. Harvey referred to the early work of William Froude, who employed models as an aid to scientific ship design and erected the first ship-testing tank at Torquay seventy years ago. He also described models for the investigation of tidal problems, the use of models in wind tunnels in aeronautical research, and the application of models in both mechanical and engineering research. He did not overlook the recreational value of model making, or the most up-to-date uses of models in the training of airmen and "spotters." An excellent collection of models was on view and numerous photographs were shown on the screen, including a selection of pictures from THE MODEL ENGINEER. The lecture aroused an exceptional degree of interest, and Mr. Harvey is to be complimented on his very complete exposition of a subject which is full of both fascination and instruction.

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Steam Car Design

A CORRESPONDENT tells me that he has been busy for the past three years on designing and building the chassis of a steam car which he affectionately names the "Dream." He has come up against certain problems in regard to steam generation on which he requires advice. We are unable to give this, but other readers with actual experience of steam car building and operation may be able to help. I am sure he would welcome correspondence from fellow enthusiasts, and so I give his name and address, which is R. M. Williams, 52, Gorse Road, Blackpool.

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A "Bradleyised" Lathe

A READER who recently wrote to me in connection with an offer of production assistance said: "I have a well-equipped workshop and though my lathe is small it has been 'Ian Bradleyised' and generally improved." This is a nice compliment to Mr. Bradley on the value of his workshop articles, which I am sure he will appreciate. There is no doubt that our many articles by various writers on making and improving workshop equipment are always carefully studied, and their practical suggestions adopted where applicable; many a workshop has been improved out of all knowledge by following the pages of THE MODEL ENGINEER.

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Ship Models at Ramsgate

MR. RICHARD BUTLER, of Ramsgate, has sent me a photograph of a very attractive group of miniature ship models which he exhibited during a recent Warship Week, and on which he was congratulated by Admiral Evans of the *Broke*. He tells me that the sight of the many ship models on view has stirred up local imagination and that the formation of a model makers' club is under consideration. He would be glad to hear from any Thanet readers who are interested. His address is 28, King Street, Ramsgate.

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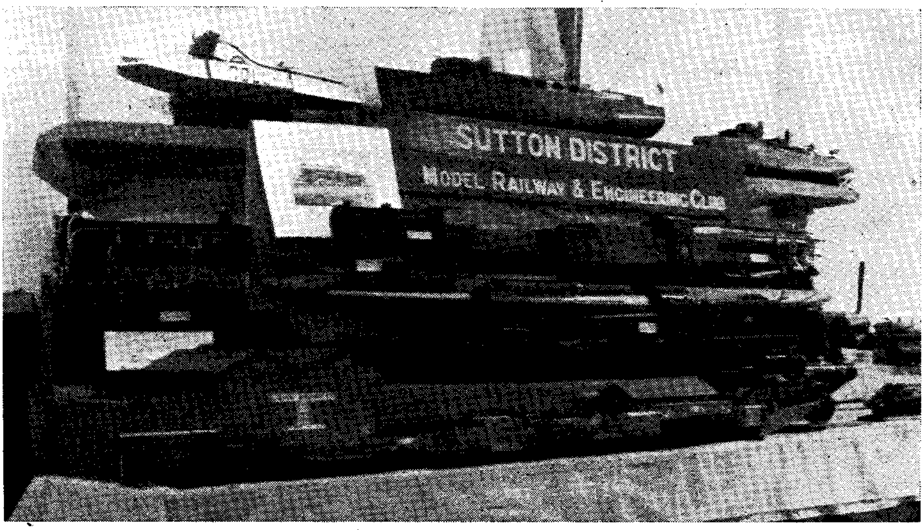
Live Steam in the U.S.A.

FOUR years ago that very enthusiastic body, the New England Live Steamers, started with seven members. Their President, Mr. Lester D. Friend, now reports that this number has grown to one hundred and four, and in such time as they can spare, the members are engaged on double-tracking their road. Mr. Friend tells me that many of the members are putting in from twelve to fifteen hours a day on war work, but in spite of this he thinks they will be glad to forget the war for a few moments occasionally and resume their hobby, if only as a measure of relief. Mr. Friend's own machine shop has been all out on naval work for a year and a half. He adds—"However, we of the English speaking world are now united and working for a common cause. This should have been straightened out twenty years ago. I hope we do the right thing when this mess is over this time."

Percival Marshall

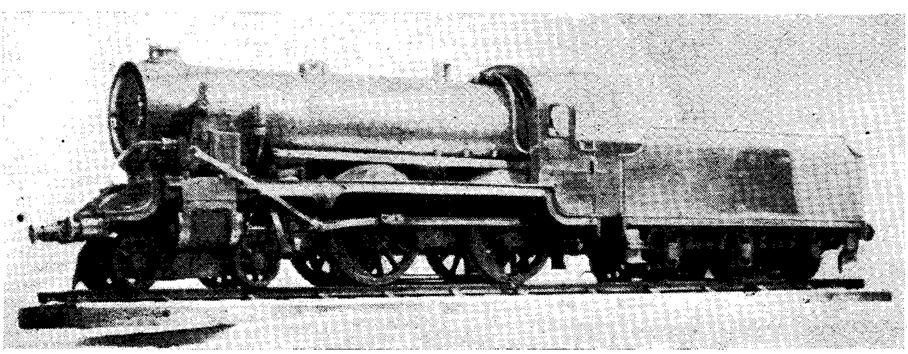
Exhibition Models for a Warship Week



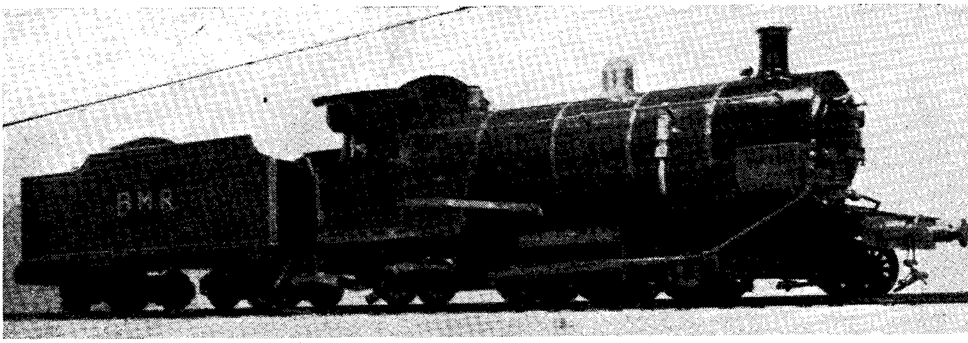
A VERY successful exhibition of work by members of the Sutton District Model Railway and Engineering Club was held in connection with the recent local Warship Week, and, in view of present difficulties, the muster of models was surprisingly large, and included examples from practically every branch of model activity.

The steam locomotives exhibited included a $\frac{3}{4}$-in. scale "Pacific" *Silver Queen*, by Mr. H. M. Sullivan; a $\frac{1}{2}$-in. scale 4-4-0 "Schools" class loco., by Mr. W. L. Hayward, who also exhibited an excellent water-colour painting of a loco. of this type, and a group of miniature steam pressure-gauges, complete and in parts; a $\frac{3}{4}$-in. "Pacific" express loco. *Smeaton*, and an unfinished chassis for a narrow-gauge South American tank loco. by Mr. T. Rowland; a $2\frac{1}{2}$-in. gauge Colonial express locomotive by Mr. E. W. Randall; a $\frac{3}{4}$-in. scale rebuilt loco., *Kestrel*, by Mr. R. R. Johnson; and a model locomotive of 50 years ago by Mr. W. Dendy. Several examples of locomotives in course of construction were shown, including *Ten-to-Eight*, by Mr. W. Dare; a 4-6-2 free-lance 3-cylinder by Mr. I. L. Little; *Princess Royal*, by Mr. R. Goodrum; and *Princess Marina*, by Mr. R. R. Johnston.

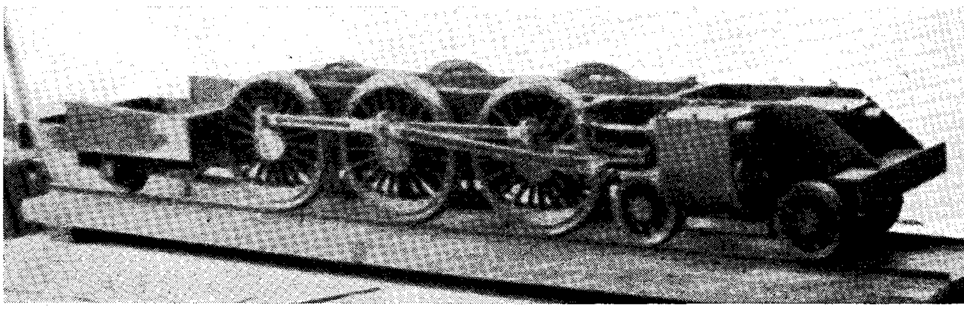
Model railway equipment included a complete layout by Mr. H. Cormack, with three Midland type locos., a munitions train, and station, with factory buildings in the background, all in gauge "O." Mr. S. W. Pearce exhibited a scale model signal lever frame



$2\frac{1}{2}$-in. gauge Atlantic loco. "St. Hilda," by Mr. I. Little.



$2\frac{1}{2}$-in. gauge Colonial narrow gauge loco., by Mr. E. W. Randall.



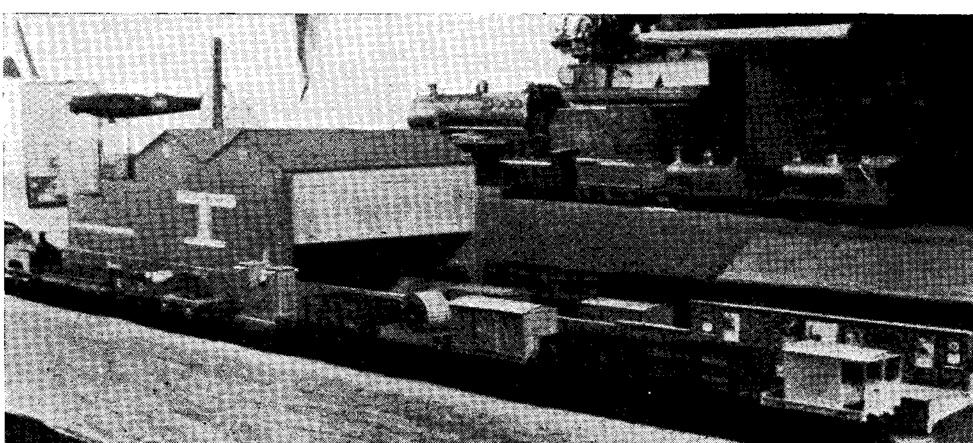
$3\frac{1}{2}$-in. gauge 3-cylinder loco. chassis, by Mr. I. Little.

and various working model signal instruments.

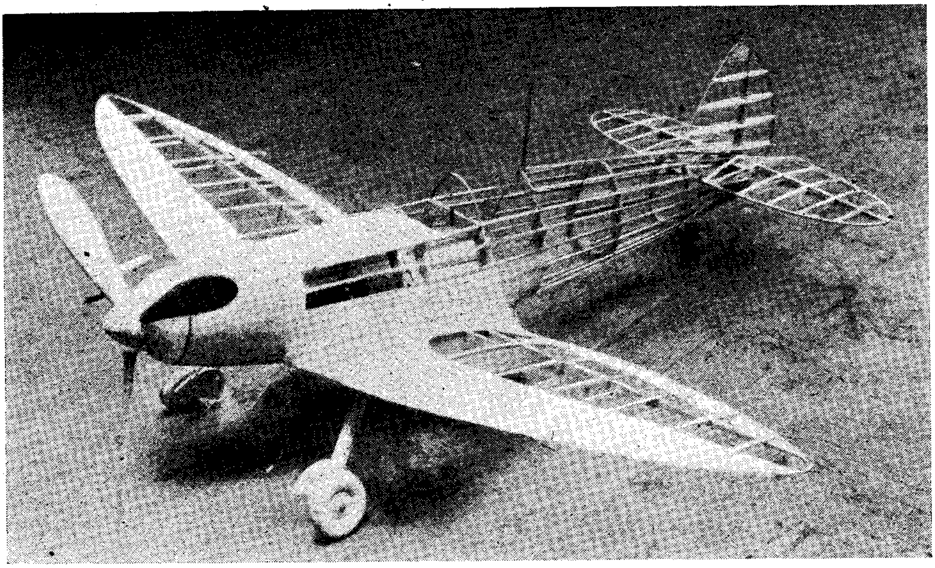
A number of excellent stationary engines were shown, including a fine undertype engine by Mr. F. A. Mills, a horizontal engine and a compound marine engine by Mr. Geo. Baynter, a horizontal steam engine and a two-stroke petrol engine by Mr. T. Rowland.

Power boats were represented by Mr. P. G. Johnston's steam yacht hull (built by the late Mr. Geo. Braine), a steam-driven destroyer by Mr. W. L. Hayward, and a 15-c.c. speed boat by Mr. E. T. Westbury.

Model aircraft included a free-lance low-wing flying model by Mr. W. L. Hayward, and a skeleton model of a supermarine



A munitions train, with station and factory buildings, in gauge "O", by Mr. H. Cormack.



A flying model "Spitfire" in course of construction, by Mr. I. Little

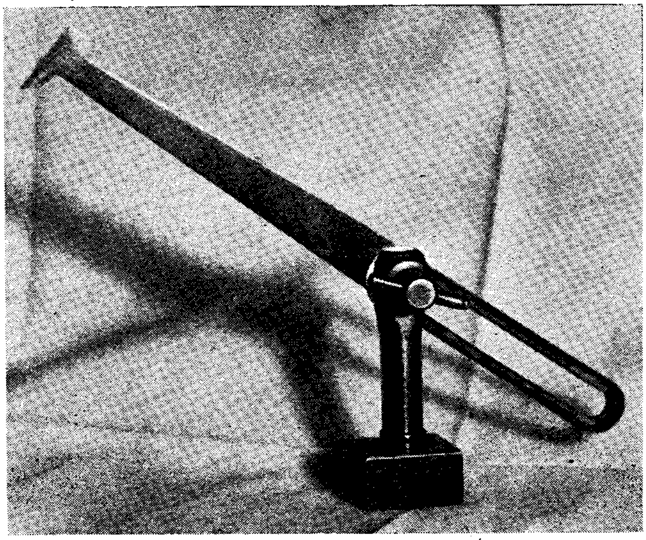
"Spitfire," by Mr. I. Little. A pioneer example of a model aircraft petrol engine was shown by Mr. E. T. Westbury.

In addition, many miscellaneous models and items of equipment, both finished and unfinished, were shown. These included an unfinished electric clock movement by Mr. Geo. Allen; a vice for sheet metal parts by Mr. S. W. Pearce; a horizontal steam pump by Mr. W. Dendy, and a duplex donkey pump by Mr. I. L. Little; and a model ship's cannon of the Nelson period, complete in section of hull with gun port, by Mr. Higgs.

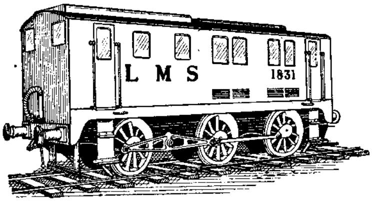
A Handy Little Gauge

Here is a gauge, adaptable in a great many respects and quite easy to make. It has a variety of uses, such as the testing of parallels in different planes, lathe work, checking the alignment of wheels on models, etc.

Its simple design can be followed from the illustration; a slotted standard carries the adjustable leg, and is mounted upon a squared-off steel base about 1 in. by 1 in. by $\frac{3}{4}$ in.



The adjustable leg has an end comprising a pointer and small flat, and for test purposes either can be used by reversing the leg in its base.—P. Reeve.



★ EDGAR T. WESTBURY'S 1831

Details of the Carburettor

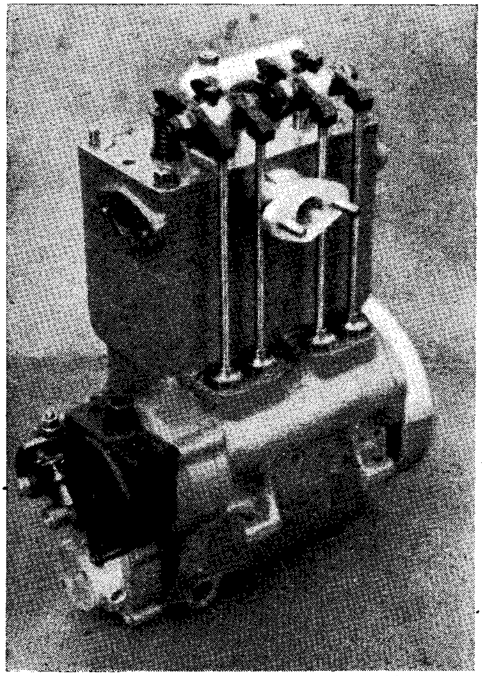
THE method recommended for dealing with the jet tube, shown in Fig. 106, is to turn the upper external portion first, and re-chuck with the aid of a simple chucking fixture to machine the lower portion and drill the centre.

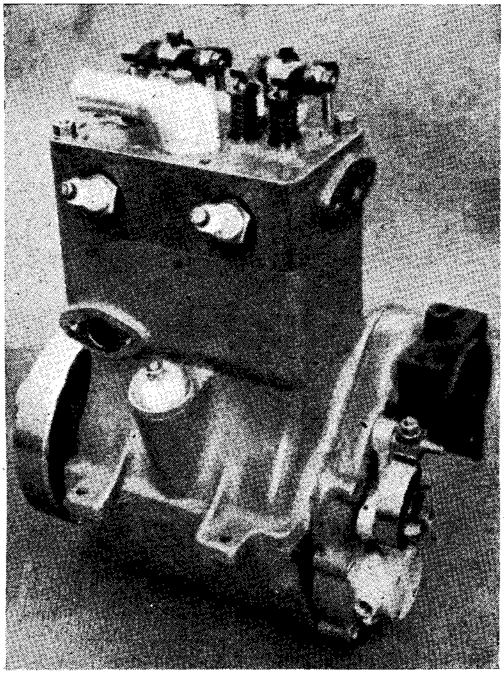
It will be seen that the hexagonal collar is specified as approximately $\frac{3}{8}$ in. diameter across flats ; this figure is intended only as a guide, as any hexagonal brass rod available, of a near size, and which can be turned with a stock spanner, may be used. Very likely no hexagon stock at all may be obtainable, in which case it will, of course, have to be made from round bar, and filed or machined to shape afterwards.

Turn the outside to the dimensions shown, and cut the thread with the screwcutting gear, or with the aid of a tailstock die-holder, so that it is exactly true and a good fit for the tapped hole in the body. A groove should be turned with a round-nosed tool, $\frac{1}{8}$ in. above the shoulder, to provide a communicating passage, in the event of the cross hole being out of line with the passage from the float chamber when the jet tube is screwed home. If desired, the centre hole in the tube may be partly drilled at this setting, to reduce the amount of drilling to be done from the other side. It is permissible to drill this hole oversize, say No. 55 drill, to a depth of $\frac{1}{2}$ in. from the upper tip.

In order to re-chuck the jet tube accurately, a piece of material should be drilled and tapped truly to fit the threaded portion, and the jet tube screwed into it. A very simple and convenient dodge is to use the gland nut for this purpose, while it is set up for drilling and tapping. Details of this nut are also shown in Fig. 106, and it will be

* *Continued from page* 316, "*M.E.*," *April* 2, 1942.





Two views of "1831's" engine, as constructed by Mr. Ian Bradley.

seen that it is drilled through with an 1/8-in. hole, which can be utilised as a pilot bore, to ensure the centralisation of the jet tip.

Turn and thread the lower part of the jet tube, as previously described for the upper part, and drill it dead truly for a depth of 5/8 in. with a 5 B.A. tapping drill. Make sure that this drill is ground to a nice point, so that the No. 60 drill will centre itself in the bottom of the hole without any fuss. It is, of course, important that the two bores should be concentric, but it is not desirable to use the No. 60 drill as a pilot for the full depth of the tapping size drill, owing to the greater difficulty of deep drilling with such a slender drill, and the risk of its wandering out of truth.

In using very small drills in the lathe, I find it best not to hold them in the tailstock chuck, as the ordinary screw feed is not sufficiently sensitive for fine drilling, and it is very difficult to know whether the drill is cutting efficiently or seizing up in the hole. I generally hold the drill in a small pin-chuck, which is put in the tailstock chuck and the latter adjusted to a *sliding* fit over it; feed pressure is then applied to the pin-chuck with the fingers. This enables the feed to be gauged by the sense of touch, and any tendency of the drill to seize may be forestalled by allowing the pin-chuck to slip round. A high lathe mandrel speed is essential, and in my experience, most amateurs are afraid to run their lathes fast enough for delicate jobs like this. Nothing much less than about 1,000 r.p.m. is really adequate for fine drilling, but as prolonged running at this speed is not good for most small lathes, an "emergency" high speed may be arranged by the use of an extra countershaft pulley. Many people fit up an emergency low speed for dealing with heavy work in a small lathe; in my opinion, a more frequent requirement is for a specially high speed to deal with delicate or small diameter work.

Of course, if one has a tailstock with sensitive lever feed, the pressure on the drill can readily be gauged; and if, in addition, a high-speed drilling attachment, like that made by Mr. Ian Bradley, is available, the problem of obtaining adequate drill speed is also solved. I have dealt with the drilling of the jet orifice in some detail, because I find that some beginners encounter trouble with this operation, and only succeed in producing eccentric holes or broken drills for their pains; there is no need whatever for this state of affairs if reasonable care, combined with correct methods, is observed.

The end of the tapping hole is opened out to 1/8 in. diameter, preferably with a D-bit, for a depth of 1/4 in. from the end, and an internal bevel of about 30 deg. machined on the end face, after which the hole is tapped with a 5 B.A. "second" tap as far as the latter will go, taking the utmost care to produce an axial thread. After removing the jet tube from the chuck, a No. 48 cross hole is drilled in the groove, and the tap run up the centre hole again to clear out internal burrs formed in this operation.

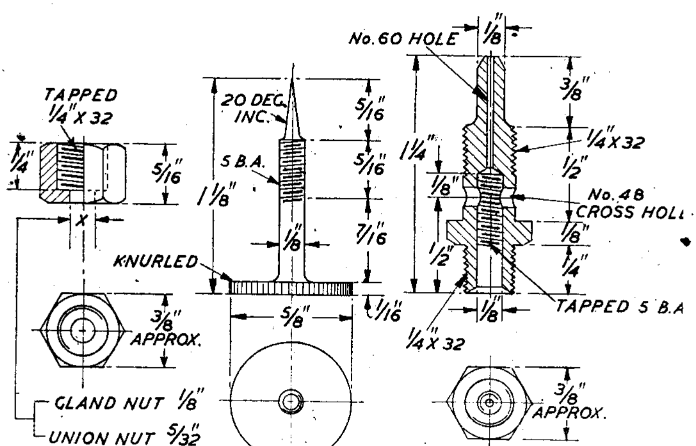


Fig. 106. Jet tube and screw, also gland and union nuts.

It may be mentioned here that those readers who prefer a fixed jet may use one in this carburettor if they wish. The external shape of the jet may be precisely the same, but the bottom end is fitted with a blank cap nut instead of a gland. A No. 48 hole is drilled from the lower end for a depth of 1 1/8 in., leaving 1/8 in. for the length of the capillary orifice. The drilling of the latter is a matter which calls for no little care and skill, particularly as it is extremely difficult to obtain a drill sufficiently small in diameter for the purpose. It will be found advisable to drill the hole not larger than 0.010 in. diameter ("ten thous."), which may be done by taking a piece of piano wire of this size, and oil-stoning it down into a flat spear-point drill. Hardening and tempering are not usually necessary if the right grade of wire is used. The drill is applied in the way already described, and the size of the hole adjusted by broaching with a fine needle broach until the required discharge output is obtained.

Another method of producing capillary jets, which may appeal to those who do not like handling microscopic drills, is to take a piece of small diameter copper tube, thoroughly anneal it, and reduce it in size by means of wiredrawing dies until the required bore size (gauged by means of a suitable piece of wire) is reached. A short piece of the tube is then cut off and driven or sweated into a hole of appropriate size in the top end of jet tube. It is also possible to reduce the end of the jet tube itself, to produce the same effect, by means of a rolling or burnishing process with a tool similar to a double knurling tool, but having smooth wheels. The material used in this case, must, however, be a form of brass, or other alloy, which is intended to be worked by drawing or forging, and it must be kept well annealed; ordinary brass or "screw rod" is much too brittle in nature, and can only be annealed to a very limited extent.

A fixed jet made in this way will have slightly different characteristics to the adjustable jet, as the actual orifice of the latter is annular, and is below the normal fuel level. It might thus be described correctly as a "submerged" jet, though this fact is not utilised as a means of compensation; it has, however, the practical advantage that the portion of the tube above the orifice holds a small reserve of fuel when the engine is idle, which assists starting from cold. Taken all round, and having had experience with both fixed and adjustable jets, I find the latter much less difficult to make and calibrate, and just as satisfactory in use, provided that itching fingers can be kept away from them after they have been correctly set.

Jet Screw

It is immaterial whether this is made from the solid, or with head and shank separate, provided that the latter is attached really securely by riveting, sweating or brazing. The best material for the screw, or at least its point, is nickel silver, which is corrosion-resisting, and hard enough to resist wear. Care should be taken to cut the thread truly, and it should be long enough to allow the needle to screw right home and close the jet orifice, but not for the threaded part to be exposed beyond the bottom of jet tube when normally adjusted. Carefully remove the burr formed by the die at the end of the thread. The point must be exactly concentric with the threaded part, which is best assured by holding it in a collet chuck for turning; but in the absence of such a chuck, it is possible to set it true in the four-jaw chuck, by the exercise of some patience, aided by some form of test indicator if available. A steep taper on the screw-point is undesirable, and the figure of 20 deg. should be regarded as the maximum allowable; adjustment is much facilitated by making the taper fairly fine, and the use of a large knurled head also assists matters in this respect.

Gland and Union Nuts

Some reference has already been made to the machining of the gland nut; the union nut used on the feed inlet to the float chamber is identical, except that the hole is enlarged to take the pipe nipple, which cannot be made less than 5/32 in. diameter over the shank. The hexagonal material used for these nuts may be the same size as that used for making the jet tube. Soft cotton yarn, lubricated with soap, is the best form of packing for the jet gland.

Particulars of the nipple for the feed pipe have not been given, but should hardly be necessary, as it is just a standard type of 60 deg. cone nipple, drilled to take 1/8 in. pipe, which is attached by sweating. Some constructors may prefer to use "solderless" nipples of some approved type, which is quite in order so long as they are fitted properly and are satisfactory in use. Excessively heavy nipples or pipe fittings are to be avoided, as apart from clumsiness, they accentuate the liability of the pipe to break near the joint through the effects of vibration.

Float

To those readers who care to go to the trouble of making a metal float, it may be mentioned that an article describing how to make such floats by a spinning process was contributed by Mr. L. Mackay and published in THE MODEL ENGINEER about two years ago. Metal floats, if soundly made and sufficiently light to provide requisite buoyancy, are always, well worth while, as their behaviour is like that of Caesar's wife, unless they are subjected to actual damage, which is practically impossible while they occupy their normal residence. That does not mean to say, however, that there need be any reason to suspect that cork floats are unsatisfactory, provided that they are treated so as to fill up the pores and prevent them becoming saturated with petrol. The most satisfactory "dope" for this purpose is ordinary shellac varnish or french polish, applied thinly, but in a number of successive coats, until all signs of absorption are finished. This will resist the action of most "straight" fuels, but may "come unstuck" if the fuel contains alcohol. Cellulose dopes are sometimes used instead of spirit varnish, but there are fuels in existence which have a solvent action on cellulose too—so what?

It may be mentioned that the carburettor

floats of certain well-known aircraft engines have been made of cork—I cannot say for certain if they still are—in order to resist the tendency of the air enclosed in a metal float to burst or severely strain it at high altitude, when the external air pressure is considerably reduced, or on the other hand, for the float to collapse when "boost" pressure is applied to the air intake by the supercharger. These cork floats were perfectly satisfactory under all conditions of service.

Incidentally, it may be mentioned that balsa wood, so beloved by aero-modellists, is lighter than cork and much easier to machine, but it will absorb dope like

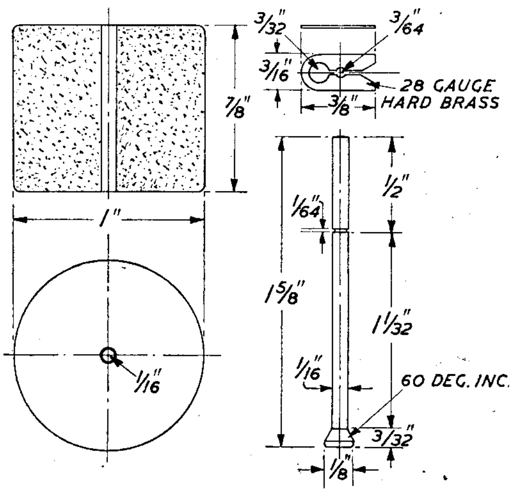


Fig. 107. Float, needle valve and retaining clip.

a sergeant-major absorbing—er—cold tea, shall we say?

The float, whatever material it may be made from, is of the dimensions shown in Fig. 107, with a hole through the exact centre, a clearance fit for the float needle, which is also shown in this figure. Nickel silver is the most suitable material for this part, though hard brass or phosphor-bronze is also suitable; it must, of course, be perfectly straight and true over its full length.

As it is scarcely practicable to machine the needle and its head from solid material, a means of attaching the head securely and concentrically must be devised. My usual method of doing this job is to reduce the end of the 1/16 in. material to about 3/64 in., preferably by holding it in a collet chuck and turning it down. If these means are lacking, however, the needle may be held in the 3-jaw chuck with the end projecting just sufficiently, and a smooth file applied while it rotates at high speed. The head is now turned to shape and size on the end of a piece of nickel silver or bronze rod, and a true hole drilled to take the reduced end of the needle. The latter is then tinned, and without cutting off the head or removing it from the chuck, it is sweated up in position by means of a small spirit lamp—even a cigarette lighter is sufficient—held beneath it. The outer end of the needle is steadied in the tailstock drill chuck, and by rotating the lathe mandrel while the solder cools off, the axial truth of the assembly can be positively assured. A special advantage of this method is that excess solder can be machined away before parting-off the head, and any interference with the proper seating of the latter in the bore of the fuel inlet thus avoided.

The position of the groove for the retaining clip should be marked by assembling the float and the needle valve in position in the chamber, and allowing for about 1/16 in. lift of the float to close the valve. A fine slotting saw or a flat needle file may be used to cut the groove, holding the needle in the chuck with just sufficient length projecting that the groove can be cut hard up against the chuck jaws, and running the lathe at high speed. Avoid cutting too deep a groove, as it will weaken the needle.

I have used all sorts of clips and other devices to connect the needle with the float, but I find the flat clip shown in Fig. 107 to be the simplest to make and apply. It will be found that the easiest way to drill and shape the clip neatly is to sweat it to a piece of thicker material, of sufficient length to enable it to be handled without difficulty, and to unsweat it when complete. The clip will snap into place in the groove of the needle quite easily, but will be practically impossible to shift endwise by any fair means.

As an alternative to a detachable clip, a small collar or washer, permanently soldered to the needle after the float is in position, may be employed. This is perfectly satisfactory, so long as no necessity arises for dismantling the parts, but may introduce an awkward limitation on the occasions when complete overhaul or inspection is desirable. Incidentally, it should be remembered that the weight of all the appurtenances to the float gear contributes to counteract the buoyancy of the float itself, so the desirability of keeping them as light as possible is quite obvious.

(Continued on page 373)

FABRICATED WHEELS

By "L.B.S.C."

IN these days when locomotive castings are what is officially termed "in short supply"—a state of affairs which, incidentally, does not seem to apply to officials themselves!—any means of eliminating castings is not only worthy of attention, but very welcome. During the years these notes have been appearing, I have fully described various ways of building up locomotive components from sheet, tube, and rod material, but have not dealt with wheels, as wheel castings were usually very plentiful, and traders stocked a great variety of sizes. Now they are difficult to obtain, several readers have taken up the question of "fabricated" wheels, and want to know whether it is possible to make a substitute for a cast wheel by any other means than cutting it out of the solid. The latter is a job requiring more patience and perseverance than most of us possess; if memory serves me right, Dr. J. B. Winter took *six weeks* to carve out *each wheel* of his beautiful Brighton "D2" mixed traffic engine *Como*. Your humble servant has built a complete 2½-in. gauge locomotive, from A to Z, in the same time!

Well, it so happens that a little while ago an old friend (the inventor of the Briggs firehole ring, to be exact) sent to me an old locomotive which he built many years ago. He values it very highly for certain sentimental reasons, and wanted to know if it would be possible to make it steam and pull a decent load continuously. She is an old type 2-2-2, a cross between a "Lady of the Lake" of the old L.N.W.R., and a Sacre single-wheeler of the M.S. and L., and runs on 2½-in. gauge. She was built in the days when a big boiler was supposed to be one of the absolute essentials for successful operation; so when I tell you that the boiler is only 2¼ in. diameter, to preserve a "scale" appearance, you can put two and two together for yourselves! Anyway, I hope in due course, if I am spared, to make her steam and pull at least a kiddy for as long as the fuel and water lasts; but the interesting thing about her is that ten of her twelve wheels (engine and tender) are "fabricated." The driving-wheels are an old brass pair which I gave to my friend way back in the dim and distant past; and I believe they were a product of the old Aldgate shop, "Steven's Model Dockyard."

How the Wheels were Made

The fabricated wheels have a cleaner appearance than most castings. The rims were made from slices parted off a piece of steel tube 1¾ in. diameter and ⅛ in. thick, each being ¼ in. wide. The centres are cut from 1/16-in. steel sheet, each one having eight spokes formed by drilling and filing, the latter being done by aid of a jig. The centres are a tight press fit in the rims, and are soldered in addition, the fillet of solder helping to give the appearance of a casting. The flanges are flat rings of 1/16-in. steel sheet, 3/16 in. larger than the rims on the outer diameter, whilst the inner diameter is the same as that of the inside of the rims. They are riveted and soldered to the backs of the rims. Six of the wheels are only soldered to the axles, but the other four have bosses made from rod, soldered into holes in the wheel centres, and drilled to accommodate the axles. These wheels run very well indeed on my road, the only drawback being that there is no radius where tread and flange meet, so that one or the other of the flanges of each pair bears against a railhead all the time, the treads being, of course, cylindrical.

This ingenious method of making wheels only needs bringing up to date, as far as actual construction is concerned, to make it quite suitable for present-day practice, the resulting wheels being every bit as good as the usual cast variety. Suppose, for instance, six 1¾-in. tender wheels are required. A bit of iron or steel tube this diameter and a couple of inches long will make the rims; gas or steam barrel would do quite well. Either chuck in three-jaw and part off six ¼-in. slices, or else saw them, and chuck each separately to true up each side. If the inside is rough, true it with a boring tool. Cut six discs of 3/32-in. sheet steel, such as is used for 2½-in. gauge locomotive frames; they should be a little larger than the inside diameter of the rims. Drill a ¼-in. hole in each, approximately in the centre; mount the lot on a spindle between two nuts, like our "juice" friends do with armature lamination stampings, and turn them to a tight press fit in the rims. One can then be marked out and filed to form the spokes (ten would be stronger than eight) and that one used as a jig to file the rest. Press a centre into each rim, so that it is a bare 1/16 in. from the edge, making certain that it is pressed in truly same distance from the edge all around.

Now cut out six rings from 3/32-in. sheet steel, the outside diameter being ¼ in. larger

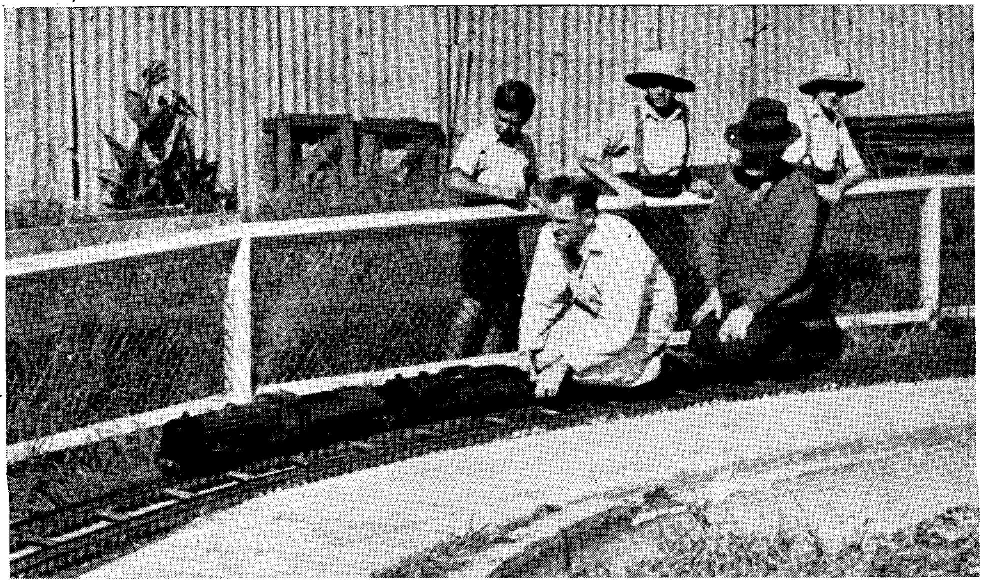


Photo. by] **Double-heading on the Sydney Club track.** [*Sergt. R. Brown.*

than the rims, and the inner diameter same as the inside of the rims. Attach these to the back of the rims by a couple of small rivets in each; bits of domestic pins would do for this. Turn up six bushes, from ⅜-in. round mild steel; chuck the rod, face, centre, drill down ½ in. or so with No. 15 drill, turn down 3/16 in. of the outside to ¼ in. diameter, a tight push fit in hole in wheel centre, and part off at ⅜ in. from the end. Fit one into each wheel centre, from the flange side; the smaller diameter should just come through the face, and project a little beyond the tread of the wheel. Put each wheel on a piece of rod that is a sliding fit in the hole in the boss, and spin it; if it is "all wobbly," it can easily be trued up by means of finger pressure only.

When O.K. lay each wheel in the brazing pan; put a fillet of brazing flux (Boron compo paste, or any similar preparation, if possible; if not, borax powder and water mixed to a creamy paste will do) around the flange, also inside the rim of the wheel, and around the boss. Blow up very carefully to bright red, and run a good fillet of ordinary brazing strip, or brass wire, around each joint. Let cool to black, and then quench out in clean cold water.

The fabricated wheels are now finished off just as if they were castings, by the method I described for *Molly's* wheels. Chuck each by the tread in three-jaw, take a very slight skim off the back and boss, and poke a 3/16-in. parallel reamer through each boss. Next mount each on an improvised "faceplate" made from an old casting or metal disc 1¾ in. diameter, with a 3/16-in. screwed peg in the middle, secure with a nut, and take a light cut at slow speed over the treads and flanges, turning the fillet of brazing metal between tread and flange, to a nice even radius, and reducing the diameter of the flange to 3/32 in. above the tread. Round off the flanges with a file. Then turn off any blobs of brazing material that might be misadorning the joint between rim and centre, and radius off the same stuff around the boss. The wheels are then complete; but note carefully—when pressing them on to the axles—don't rely on the rim for support. Drill a ¼-in. countersunk hole in a small block of brass or steel, put it over the projecting bit of the boss, and press the axle in against that, leaving the rim entirely free. There is no need for the wheel to be extraordinarily tight on the axle, as a steel boss on a steel seat "holds" better than a cast-iron boss on a steel seat; and quite a medium press fit will prevent the wheel from ever moving of its own accord.

"Going To Town"

(*Continued from page* 138)

"Ewell — Cheam — Sutton — Wallington —West Croydon and London! Now for London—London Bridge train!" We hear the strident voices of the local porters above the hiss of *Purley's* balances, and the "siss-phut-siss-phut!" of the Westinghouse donkey as it builds up the air pressure for

the brakes. Off goes the starting signal at the end of the platform, and a glance at the station clock shows that we have only a minute or so before we must be on our way to town. Bang—bang—crash! go the carriage doors; I wonder how on earth they stand it! A shout of "Hurry up there, please—plenty of room forward!" accompanied by the sound of running feet, indicates the arrival of the last-minute stragglers; a couple more bangs and crashes, then we lean out of the cab and look back along the platform. The guard is just waving his flag. "Phreeeep!" goes his whistle. "Om-m-m!" replies *Purley* as we touch the whistle handle, and over goes the regulator just half way. There are no half measures about the way the little tank responds; she gives a mighty heave, sustains it, and the nine bogie coaches come trailing after her as the platform starts to slip backward. Wuff! wuff! wuff! The sound seems to come from the firehole as well as from the chimney; as a matter of fact, it actually does, as a certain amount of air is sucked in over the fire, in order to burn up the smoke, keep the tubes clean, and add to our "coal money." We look back as the last coach leaves the platform; the guard has stuck his green flag out of the window, so all is O.K. and we turn to look ahead. The engine is rapidly accelerating; back comes the "lever" (which is a wheel and screw) about one-third, and we pull the regulator wide open.

Acceleration that Counts

On fast suburban timings, it is acceleration that counts (which is where "Milly Amp" scores in present-day operation) and the way *Purley* is getting a move on is a real treat to any engineman; but she needs steam to do it, and both pumps are on. Whilst the blast is still fairly heavy, the fireman gives her one shovelful each side, one in each back corner and one under the door, then kicks up the flap, but the door remains open a little. The damper, of course, is wide open. We are now rattling along in fine style, so fetch the lever back a little more yet, and are still picking up speed as we pass Ewell up distant, which is "off."

Then, as we approach the station, on goes the blower, we shut the regulator and drop the lever into full gear. If this is not done, the compression will push the valves off the faces and kick up a terrific clatter. The fireman kicks the flap down as *Purley* starts blowing off again, then we ease over the brake handle and reduce the air pressure in the train pipe a few pounds, bringing the handle back to "lap" position. The brakes immediately "bite," as the triple-valves operate, and the train slows down. Plenty of folk on the platform! The engine sweeps by them, we make a further reduction of air pressure, and then, just as the train is stopping, bring the handle back to "full release." It needs a bit of "fine timing," but when once the knack is acquired we can bring the train to rest without disturbing even a straphanger's newspaper, though it is the easiest thing in the world to put the whole lot of them on the knees of the sitting passengers!

Embarkation and Acceleration

We are only allowed a minute stop, and the "embarkation scenes" are hastily repeated. Right away! and off we go again, exactly repeating the driving operations, getting the best acceleration we can out of little *Purley*, without causing her any distress. This time the fireman does not put any more coal on; she doesn't need it. We are unable to do anything startling in the way of speed just yet, as the stations are fairly close, and just as we are really getting into a swinging pace, we have to shut off and prepare for another stop; but all the same, we are keeping to "schedule," as our cousins over the pond call it, and that is no mean achievement when our little 38-ton tank engine, with cylinders only 17 in. by 24 in., 5 ft. 6 in. wheels, and carrying 150 lb. pressure, is humping along a train weighing something like 250 tons, over twice the weight she was originally intended to pull. Nowadays a three-cylinder 2-6-2 or 2-6-4 would be used for similar work!

Standing Room Only

We rattle through a cutting and under a bridge, call at Cheam for a few more "clients," pick up more still at Sutton, and again at Wallington; the train is now pretty full. We are now anxiously watching both the sky and the minutes, for reasons you will soon appreciate. There is an April shower coming, and we get the first drops as we pull out of Wallington station; we "sense" that *Purley* is going to "lose her feet"; but before she can start "dancing" we shut the regulator, open the leading sands, and give her steam again. "Prevention is better than cure," says the old saw, and we have saved a minute, and a disturbed fire, by just that one little act. Down comes a sudden rush of H_2O and thoroughly wets the rails, so we shut off the sands; she won't slip on thoroughly wet rails, and the train "pulls" much easier, as the rain "lubricates" the flanges of the carriage wheels.

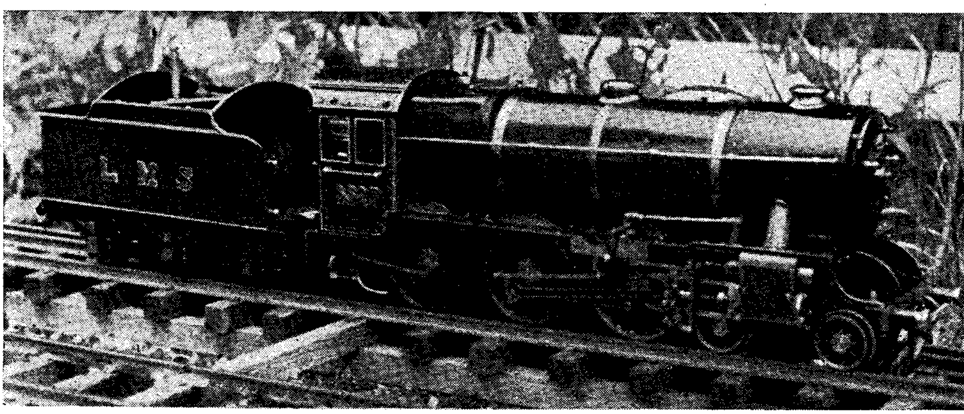
Waddon up distant is off, but we are

not stopping at the station, so we give a loud blast on the whistle to warn the passengers on the crowded platform, and buzz through, leaving them to "wait for the next." A single line, the Croydon-Wimbledon branch, comes sweeping in from the left; we sight West Croydon distants—the taller one is off, that is ours—then shut off steam again for the Croydon stop. *Purley* sweeps around the wide curve easily, and we make the first brake application just before passing under the bridge carrying the main street over the railway. The train slows down; goodness, *what* a crowd—how on earth are they all going to get aboard? "Fast to London—London Bridge only!" comes the porter's voice as the engine drifts slowly past the long platform, and makes a perfect stop at the end of it. And now we *are* going to get busy!

Oiling.

Almost before the wheels have stopped turning, we grab the "kettle" (a big copper oil feeder with a large spout), dash around to the front end, open both the valves on the oil cups above the cylinder flap, and give each a "dope" of cylinder oil and tallow, which goes direct to the cylinders. In those days, engines were not fitted with the elaborate oiling devices of the present time; reliance had to be placed on a "human" instead of a mechanical lubricator, and *Purley* only had the above-mentioned "dope cups" plus a small displacement lubricator, with screw adjustment, on the side of the smokebox. We took no risks; our valves, pistons and cylinder bores were never neglected. The fireman opens the tank lid and looks in the tank; "plenty, mate" he reports. Steam comes from the open lid, as part of the exhaust has been going into the tanks, and has warmed up the feed water.

Back to the cab; and now, an anxious glance at the time, and another ditto down the platform, where the last arrivals are scrambling to find somewhere where they can squeeze in. Thank goodness, we ran out of the rain a mile or so back, and the rails here are quite dry; the sun is breaking out again. Hurry up, passengers, *please*—but *you* don't know that if we are late leaving here, we shall be in a nice old fix! If we reach the junction with the main line "on the dot," we fit in just right between two main-line trains, following the Eastbourne up, whilst the Tunbridge Wells follows us. It is seldom indeed that the latter is late, usually the other way about; and if she "gets the road" in front of us, we shall be diverted to the local through Norwood Junction and be delayed all the way up. Time's up—shall we *never* get the right-away—yes, thank goodness, the guard whistles us off even before the last doors are shut. Over goes the regulator, over halfway this time; come on, *Purley*, old girl, show'em how to do it—and *does* she respond? We feel the terrific strain as she throws her whole effort into accelerating the crowded train, whilst the blast, as she dives under Whitehorse Road bridge, is enough to loosen the girders, and the steam beats down and fills the cab. Back comes the lever a little, and over goes the regulator to wide open. Rapidly accelerating, we pass the junction to the Victoria line, then Windmill Bridge and Norwood fork, and then comes the anxious moment—shall we get on to the main line in front of the Tunbridge Wells? We heave in sight of the junction distants; they are all on—has she beaten us?—we grab the whistle handle and give the call. Oh, what a happy relief! Off goes the local to main, we're all right now. "Om!" replies *Purley* joyously. The fireman grabs the



[*Photo. by*] **A Gauge "1" "Royal Scot" with Baker gear, built by Mr. A. Clarke, of Sydney, N.S.W.** [*Sergt. R. Brown*

shovel and slings in a few more black diamonds; on goes his pump, and the balances quieten down to a sizzle. Now our old girl is getting a swing on; we cross on to the up main, and have to run the rest of the journey in main-line time to keep our place between the two expresses. Still she accelerates; back comes the lever a little more, to the fast-running position. Norwood Junction appears ahead, all our signals off, *Purley* screams her warning, and we rush through, doing over fifty now. Whoosh! under Goat House bridge, and again under the Beckenham line. No need to touch regulator or lever any more yet, the engine knows what to do; just give her a little more oil from the cylinder lubricator. The exhaust is now just a continuous purring, and the ring of the coupling-rods sounds like a tinkle-bell; we can tell from that alone she is now doing her mile-a-minute. Anerley, Penge and Sydenham are left behind in quick succession; then, oh, horror! Forest Hill up main distant is on. Surely we haven't caught up the Eastbourne? No, it's all sereny; even as we reach for the whistle handle, off goes the board; but the signalman has all his work cut out to avoid delaying us. *Purley* yells: "Here we come, mum" in "locomotivese" and we tear past the centre platform, then she tips her head over the top of the three-mile bank down to New Cross. The water, which has previously been right up in the top nut of the gauge, now comes in sight. We bring the lever practically to middle, as near as possible without causing the "works" to rattle, and almost close the regulator. The train absolutely flies down the 1 in 100 grade, yet the little engine runs perfectly steady, and the bogie coaches ride quite easily; I'll bet none of the passengers could give our exact speed, they don't realise that suburban trains can "hop it," when the timetable calls.

We whizz through Honor Oak Park and Brockley like a brown rocket with a yellow head, slash around the long sweeping curve, and sight New Cross. Surely we will miss that little "hole in the wall" where the road crosses the railway? A long blast on the whistle this time, then, nearer 70 than 60, we go through that "hole in the wall" with a loud "ha!" (that is just what it sounds like), dash past the platforms, and just get a glimpse of "home"—the loco. sheds—on our left. We are now on the level, so pull the regulator wide open again. *Purley* maintains her speed; on past Blue Anchor, where we overtake and pass a South Eastern train, which will delight our passengers, and then, at long last, the outer signals of London Bridge appear; we open the blower, shut the regulator, and drop the lever into full gear. A brake application reduces speed to about 25 m.p.h. and we cross Tower Bridge Road; the indicators on the signal-post direct us through the maze of points and crossings to No. 2 platform.

Another brake application as we enter the platform, and *Purley* comes to rest within a few feet of the buffer stops, right on the dot. That main-line train, still discharging passengers at No. 5, is the one we have been following; and whilst the streams of passengers from our own carriages are still trooping past our engine, we see the Tunbridge Wells train come slowly into No. 6. Close work! But that was railroading in the days before "Miss Milly Amp" took the job over. We have very little fire on the bars, but a full pot of water; and as we have half an hour to wait before starting the next trip, we will proceed to the siding and have a snack of "tommy" and a refresher from the tea-bottles, as soon as they pull the empties out. I reckon we have earned it—what say you?

"1831"

(*Continued from page* 368)

The float needle valve should require very little in the way of grinding in, if both mating parts are correctly machined. Errors in the latter respect are bound to cause trouble, no matter how drastically or frequently the valve is ground in. A mere touch with a little metal polish, sufficient to show an uninterrupted marking around both valve and seating, is all that will normally be required; heavier treatment will only produce ridges or scores in both surfaces, which are more likely to defeat the intended purpose of producing a fuel-tight seal than otherwise.

Some latitude in the level at which the float will act to cut off the fuel supply is permissible, with the form of adjustable jet specified. Fixed jets are generally more critical in this respect, and usually call for careful adjustment of the float gear to obtain the best results. It is extremely difficult to ensure an exact fuel level in small carburettors, owing to the capillary action of the fuel in small passages (commonly termed "creeping"), and also the wide variation in the buoyancy of small floats.

(*To be continued*)

"Non - Leak" Clacks

Mr. E. ROWBOTTOM, of Cape Town, submits a design which overcomes a lot of trouble

IN THE MODEL ENGINEER dated the 16th October, 1941, "L.B.S.C." gives us a very full description of how to make "Non-Leak" clack-boxes, mentioning also some of the causes of failures to hold pressure of these tiny fittings. I would like to add two more "Causes," and the remedies applied to correct them :—

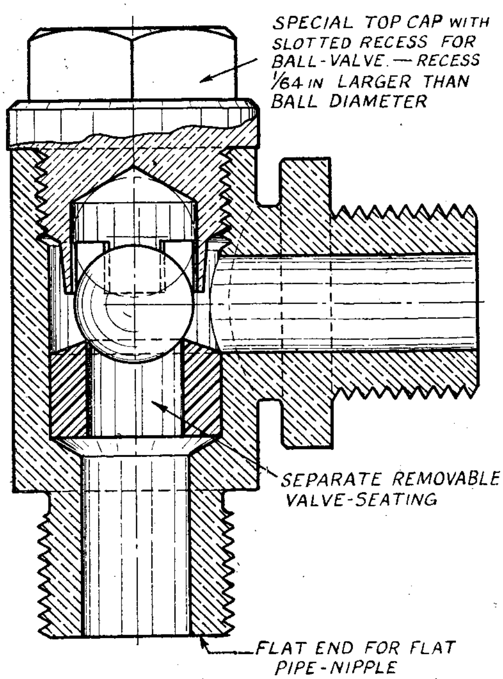
(1) With the usual 'coned' type of pipe connection, a certain amount of distortion of the seating takes place when tightening up the union unit; this probably would not happen to such a great extent as to distort the seat when the fitting is of robust proportions, but fittings that must look right are not usually strong enough to counteract any outside strains. I have therefore made it a practice of fitting flat pipe nipples which seat on the flat end of the union screw—they are easier to make than their coned brothers and remain just as steam and water tight, and the chances of distortion are reduced to a minimum.

(2) Sometimes also, the ball valve, instead of seating itself on its first bang down, rolls round with a chattering effect, which not only damages the seat but also allows the escape of water and steam until the ball decides to behave. To a certain degree, restricting the lift of the ball valve reduces this effect, but, if taken too far, seriously hampers the free flow of traffic. On the other hand, if the ball is allowed to lift too much, it usually goes along with the traffic and tries to get into the boiler through the communicating passage, with the same hampering effect. Now, if ball valves were "controlled" they could reasonably be taught to behave.

The fitting of a "recessed" top cap, which actually receives the ball when it is in its raised position and at the same time embraces the ball while it is on its seat, entirely gets over these difficulties. The recess can be such that the ball, when it is raised, is right out of the way, allowing absolutely free passage for traffic. It cannot roam round, as it is guided right on to its seat.

The seat still remains the most important part of a clack-box, and should be made, as "L.B.S.C." says, with great care. To this end in view, and also through ease of manufacture, a separate, removable seat offers the best chances of success. Besides making in the lathe at one setting, a variety of materials, to suit the service required, may be chosen from. Rustless steel takes a lot of beating, as it does not fur up as quickly as brass or bronze, and in conjunction with rustless steel balls, makes a fine combination for long and reliable service. If anything should happen to the seat and it gets damaged it can easily be removed and replaced with a new one.

The enlarged sketch herewith explains itself, and is the type of clack-box the writer has been using, with success, for some time now.



*A Method of Making a 17-Division Dividing-Plate

By D. HAWKINS

THE method about to be described will be, I think, almost self-explanatory from a glance at the drawing.

To start with, however, we have to find the length of the chord of 1/17th part of a 5-in. circle. This can be got from the following formulae: Sin. of half the angle θ $\times$ ($\frac{1}{2}$ the rad.) $\times$ 2, or can be got from almost any book containing tables and formulaes for mechanics. (In this case it was taken from a Fowler's pocket book.)

In this particular case the length of chord works out at 0.919 in. Having got this dimension, we can now proceed to turn the two buttons on which the accuracy of the job depends.

As will be seen from the drawing, det. 1 is just a steel button having a head 0.919 in. diameter, and a spigot on the underside. Det. 2 is a drill bush, having a hole in it the same size as the spigot on det. 1, and also having a head on it 0.919 in. diameter. The rest of the set-up is obvious from the drawing.

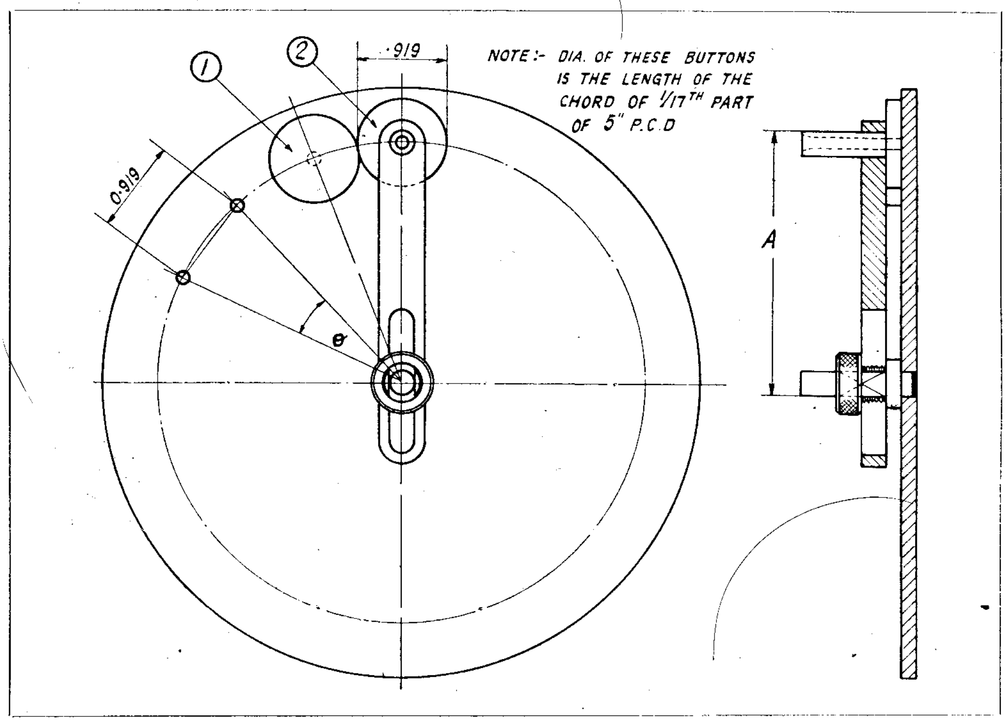
To commence work on the plate itself then, we first set the length "A" with a micrometer, so that we get the holes on the correct P.C.D. Having done this, we put a toolmaker's parallel clamp on the end of the bar holding the drill-bush, and clamp the bush and the plate firmly together.

We then drill our first hole. When this is done, we remove the clamp, plug in the button with the spigot, swing the bar round till the large diameter of the bush touches that of the button, replace clamp, tighten up, and it is ready for the next hole.

This operation is continued until the job is done.

This method, beside being extremely quick, is absolutely fool-proof and simple, and will give a really accurate result.

An entry in our recent Division-plate competition.



Details for a spacing device for making division-plates.

* Mr. J. W. Pattison

Designs a Lathe —

and Suggests some Gadgets for it

WHEN the drawings were completed, these surfaces came in for a lot of criticism from myself. Particularly, they did not achieve one of the objects desired, that being slides which would remain entirely free from chips or, even worse, grit if grinding was to be attempted. Any attempt to eliminate this disadvantage appeared to bring in even greater troubles. An open-top bed would do little to relieve the situation, as the slides would still remain exposed. Transferring the slides to the front and rear face of the bed was thought of, but this meant no end of troubles, such as leadscrew mounting, tailstock fixing, etc. On the whole, therefore, it was thought better to leave it alone, and possibly provide some form of telescopic apron to cover the exposed parts; but whether this would be worth the trouble, however, is doubtful.

It is assumed that the bed would be ground, and its accuracy would depend upon the parallelism of the vertical faces of the front and back shears of the bed, and, of course, the flatness of the top surface. As the head and tailstock are both located against the rear vertical face, and, as already mentioned, the saddle is located against the vertical face of the front shear, alignment should be preserved at all times.

The Headstock

First in importance is the mandrel. It had to be large because I particularly wanted 1-in. collet capacity; therefore, the minimum diameter had to be 2 in.

Only when it was drawn out did I fully realise why a large mandrel would be expensive, for almost everything else in the headstock had to be increased in like proportion. Just imagine what diameter pinion is required and you will soon realise what dimensions a 6 to 1 back gear will assume. Also, one cannot mount standard-size change wheels direct on so large a mandrel, assuming it is to be bored out maximum diameter as in this case. Quite a lot of scheming had to be employed to keep everything within reasonable dimensions and yet provide large wearing surfaces.

Everyone appears to be in general agreement that plain bearings are best for lathe mandrels, and as I have no fault to find with phosphor-bronze carrying a hardened and ground mandrel, that is what is suggested. No doubt, cast-iron is equally good, though I have never worked a lathe so fitted long enough to form any opinion of my own. Personally, I would favour ball-bearings, but dread the warnings of others.

I have experienced some of the troubles attributed to ball-bearings, but as these bearings had seen a lot of service I was not convinced that the faults could not be rectified. Whatever the reason, it still remains a mystery to me why the makers of some of the finest precision lathes employed on the production of delicate work, such as instrument making, use ball-bearing headstocks and expound their virtues as though they were the main reason for the accurate work produced. Will someone with experience of these small modern machines let us have some facts? It would appear to me that many of the troubles of the earlier machines must have been overcome in the modern type. However, hard phosphor - bronze adequately lubricated, appears satisfactory enough to specify in this case. These bearings are coned on the outside for adjustment and are of square dimensions as regards length to diameter. Both front and rear bearings are of the same size. A ball-thrust washer takes the end pressure on the mandrel.

The drive enters the headstock by a vertical shaft, thence to a two-speed gear through a worm and wheel. A $\frac{5}{8}$-in. face is allowed on all gears in the headstock. The gear change is affected by a lever on the outside of the head, giving high, neutral and low, the neutral position allowing the motor to be run without turning the mandrel.

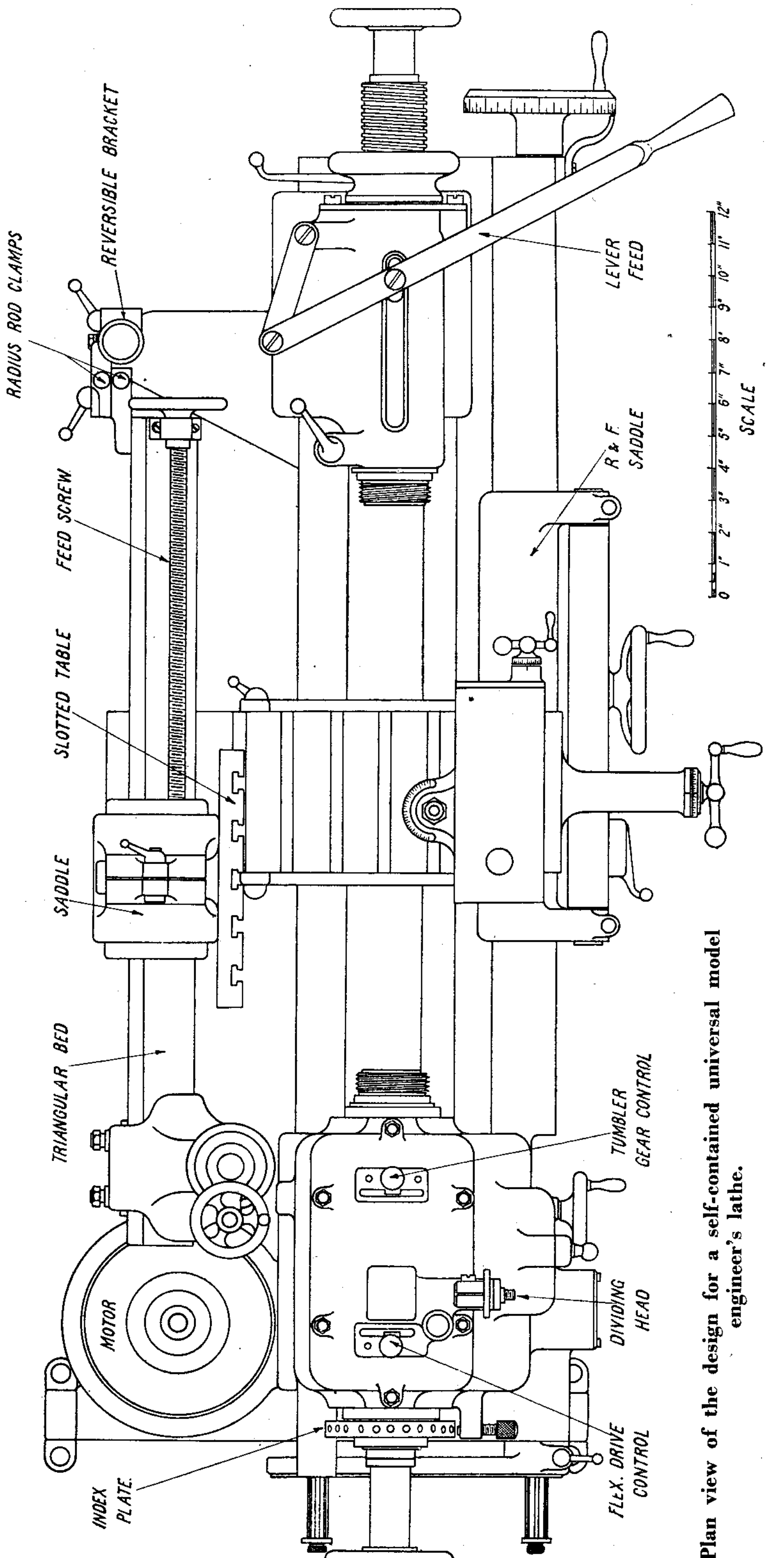
From the top of the vertical shaft the auxiliary drive is taken through a clutch, controlled by a small spring-loaded lever placed near the rear bearing. A corresponding lever near the front bearing works the tumbler gears.

Provision is made for dividing-plates at the front of the head. The protruding shaft carries at its rear end a steel worm $1\frac{1}{8}$ in. in diameter, which meshes with the mandrel

* *Continued from page* 355, "*M.E.*," *April* 9, 1942.

gear. This shaft is housed in an eccentric sleeve bearing to allow for the worm being taken in and out of mesh, and for adjustment of backlash. The front end of the shaft carries the quadrant-arm and spring plunger, whilst changeable dividing-plates and sectors are carried on the front end of the bearing. It is also possible to fix a handle in place of the quadrant and plunger and thus form a hand drive to use in conjunction with the permanently-attached plate situated at the rear end of the mandrel. This latter plate is $\frac{1}{2}$ in. thick and 4 in. diameter, drilled around its edge with 24 holes, $\frac{1}{4}$ in. diameter, which are entered at right-angles by an equal number of $\frac{1}{8}$-in. tapped holes located around the side face of the plate. Being permanently fixed, it is always available for the direct dividing of work into squares, hexagons, etc., the locking plunger being a 5/16-in. knurled-headed screw, turned $\frac{1}{4}$ in. to enter the holes in the plate, and working in a lug cast in the head. Check counting may be done by inserting set-screws in the tapped holes corresponding to those required for indexing.

Two adjustable stops, having $\frac{1}{4}$-in. turned legs, may be



Plan view of the design for a self-contained universal model engineer's lathe.

entered into any of the holes in the plate and locked by set-screws. Set tangentially on the plate, they come up against the cast lug which acts as a stop. Thus by using the handle on the other dividing gear to turn the mandrel, end-milling of an arc, or any similar work, may be performed on anything held on the chuck, the positive stops preventing the rotation of the work beyond a predetermined distance.

This idea is similar to one seen at the "M.E." exhibition some years ago, and I trust the originator of this useful device will pardon my having used it here.

The only other item in the headstock is a clutch which connects the start of the screw-cutting train. Thus, everything is completely enclosed and runs in oil, adequate lubrication being vitally necessary with such a large mandrel running in plain bearings at high speeds. A cover-plate is provided for inspection and assembly. The headstock is bolted down to the lathe bed and occupies the full width of the latter.

From the headstock the vertical shaft extends downwards into the bed, and expanding Vee-pulleys connect it to the motor. This form of drive is a similar arrangement to that found on the old Zenith and Rudge motor-cycles. The former employed an expanding pulley on the engine shaft, and the back wheel with its belt rim was moved in or out to preserve the tension on the belt. The Rudge was similar, only here both pulleys expanded and contracted alternately to get the variable ratio and maintain the tension on the belt at the same time. It is this latter arrangement which is used here.

Two 6-in. pulleys give an infinitely variable speed between 30 and 2,200 r.p.m. to the mandrel, the two-speed gear in the head giving a slight overlap in the middle of this range. Variation of speed is controlled by turning the hand-wheel placed conveniently at the front of the bed.

The motor is mounted vertically on an extension of the lathe bed, and thus exposes the free end of its shaft, which is equipped with a pulley for use at any time should an extra auxiliary drive be required. To mention one example, should it be necessary to drive the leadscrew independently of the mandrel, a belt could be taken from here to a worm drive, connecting with the gear train.

The main auxiliary drive is by flexible cable taken off the top of the vertical shaft in the headstock. Judging from my own short experience of a home-made version of this type of drive, it should be a real boon. It certainly is more adaptable than any overhead, and standard cable of no more than ⅝-in. outside diameter is quite capable of taking care of all the power likely to be found in an amateur's lathe motor.

Among other reasons, it was to exploit this form of drive fully that 1-in. collet capacity was wanted in the mandrel and tailstock, since it was thought that if a well-made head of 1-in. diameter carrying screw on collet chucks was attached to this drive, this head could be slipped into the mandrel and some quite delicate work turned with it. To go a step farther and get down to work of the watch-making variety, possibly a further head would be required, together with a bar bed, this latter fitting into a hole bored in the headstock casting. Whether the necessary accuracy could be attained, however, is quite another matter. In any case, such an arrangement is only mentioned as a possibility, and no provision is made for anything of the sort here.

The speed range available from the flexible shaft is variable between 480 and 4,350 r.p.m.

The Tailstock

In capacity, this could duplicate the headstock, when all accessories would be interchangeable. A solid tailstock is to be preferred to ensure preservation of the original alignment, as it may well be called upon to perform other jobs than that usually associated with a tailstock. Slight taper turning could be accomplished by using an adjustable offset centre, or by disengaging the slide nut and using the auxiliary bed, set at an angle, as a saddle guide. The tailstock spindle is equipped with the usual screw and hand-wheel, which may be disengaged and a lever brought into use. This lever could be swung out of the way when not in use. Rotation of the mandrel is prevented by a block, sliding in a machined slot in the casting. The tailstock assembly is held firmly against the vertical rear face of the bed, being drawn up tight and clamped to the top surface at the same time by a cam, operated by the lever at the rear end of the casting.

The Saddle

It was desired here to have as large a range of movements as possible, since full use would be made of this fitment for boring and milling. The longitudinal motion along the lathe bed was of first importance. No less than 14 in. of sliding surface is used, and as this is only 2 in. wide, perfect sliding motion should be obtained, the rear of the saddle merely acting as a steady to keep it level. Adjustment is by gib-piece along the front, whilst a stiff gib holds the rear of the saddle up to its work.

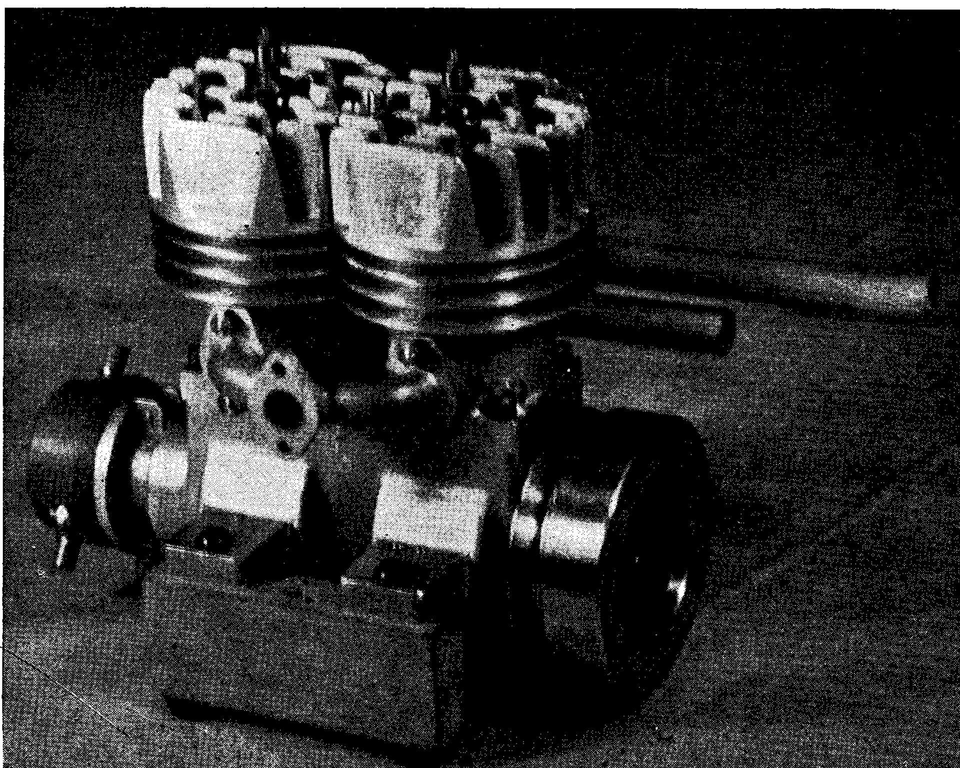
(To be continued)

*A 30-c.c. Twin Two-stroke Petrol Engine

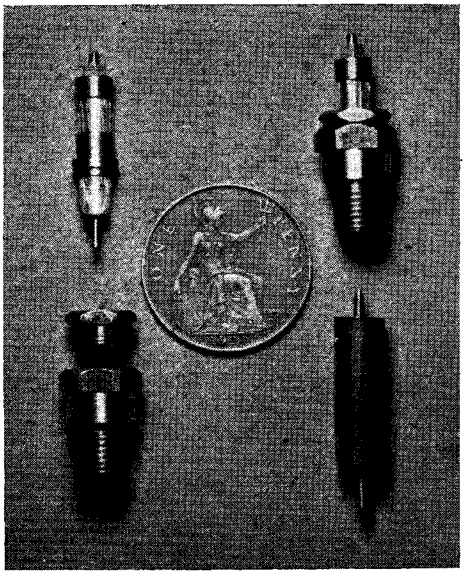
By R. A. PHILLIPS

THE induction and exhaust pipes are of copper with brass flanges brazed on. These were made by copper depositing on lead formers, the diameters of which were the inside dimensions of the pipes. The former for the induction pipe and the straight exhaust pipe, were carved out of two cast billets of lead of suitable size. The lead billets were reduced to required thickness by turning, and the shape of each pipe marked out on their respective blanks. They were then cut out with a hacksaw, filed and scraped to the lines. The section of both formers was now square, and were further filed and scraped to form them into round sections, except at the flange end of the exhaust former, which was formed into a shape to suit my requirements. Both formers were then polished. The exhaust former was then used as a pattern, and a lead casting taken from it. It was only necessary to remove the flash and ribs from the casting, before the final polishing. This one was then set to the required shape. Provisions were made in the ends of the formers for attaching the necessary connection wires for copper depositing. I do not possess the plant to perform this operation, so I enlisted the assistance of a friend of mine who kindly undertook the job for me. Upon receiving the " pipes " from him, the lead was melted out, the flanges made and brazed in position, then cleaned up all over. The stud holes in the flanges were then marked out and drilled to clear 4 B.A. The

* *Continued from page* 330, "*M.E.*," *April* 2, 1942.



A view showing the inlet side of the 30-c.c. twin two-stroke engine.



The sparking plug and component parts, compared in size with a penny.

pipes were then fitted into their respective positions on the cylinders and the stud holes spotted through the flanges into the cylinders which were finally tapped 4 B.A. The studs were then driven home and the pipes fitted.

The Sparking Plug

The sparking-plug and component parts as shown in the accompanying photograph is of my own design and manufacture, upon which, I have spent a considerable number of hours perfecting the design of the conductor and its insulation to give maximum reliability. The method adopted to make this important part is as follows :—

The conductor was made from $\frac{1}{8}$ in. dia. stainless steel and turned down to 0.080 in. dia. for $1\frac{1}{2}$ in. long, having $\frac{3}{8}$ in. of 8 B.A. thread and a 60° male centre at one end, and a fine diamond knurled to within $\frac{1}{4}$ in. of the other end. The clamping flange and protection cap, on the insulation (top left hand corner in photo.), in the first place, is a piece of $\frac{3}{8}$ in. dia. B.M.S. 1 in. long, with a $\frac{1}{4}$ in. dia. flat bottomed hole drilled 15/16 in. deep and the remaining 1/16 in. drilled and tapped 8 B.A. The insulation is of sheet mica interleaved and hand wound on to the conductor as tight as possible to a dia. such as will "screw" into the M.S. sleeve. Quite a lot of practice is required to achieve these ideals, and I may mention, the success of the finished plug depends entirely on this operation. However, having completed the winding operation it was "screwed" into the M.S. sleeve with the 8 B.A. screwed end protruding through the small hole (bottom right-hand corner in photo.), and baked in the ordinary electric domestic cooker at a low temperature for twelve hours, to remove any moisture collected on the mica from the hands during winding.

The assembly, when cold, was then pushed through three draw dies (Fig. 27), entering the threaded end first and using a small quantity of oil. The first die was 0.370 in. dia., the second 0.365 in. dia., and the third 0.360 in. dia. This operation calls for the use of a small fly press, and as can be imagined, the M.S. sleeve was now reduced to 0.360 in. dia., and the mica winding very much compressed. The removal of the unwanted portion of the sleeve was then performed by turning, exercising great care in the setting and turning to actual requirements. The body and gland nut are made from hexagon M.S. rod are simple turning operations, provisions being made for the earth on the

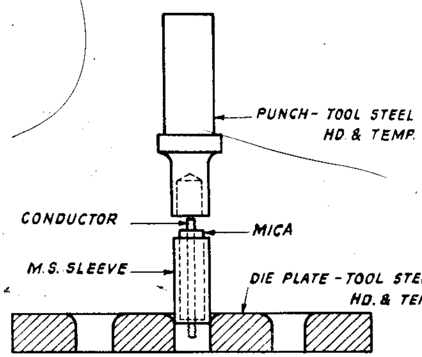


Fig. 27. The draw die and punch.

body by drilling and "D" bitting a flat bottomed hole to within 1/32 in. of the start of the $\frac{3}{8}$ in. × 24 t.p.i. thread, then drilling a suitable size hole centrally, though the 1/32 in. wall to form an annular gap between the electrode and body.

I have designed the carburettor, but owing to enemy action, I was unable to proceed with construction for the time being, but I hope in the near future to be in a position to carry on and complete the job.

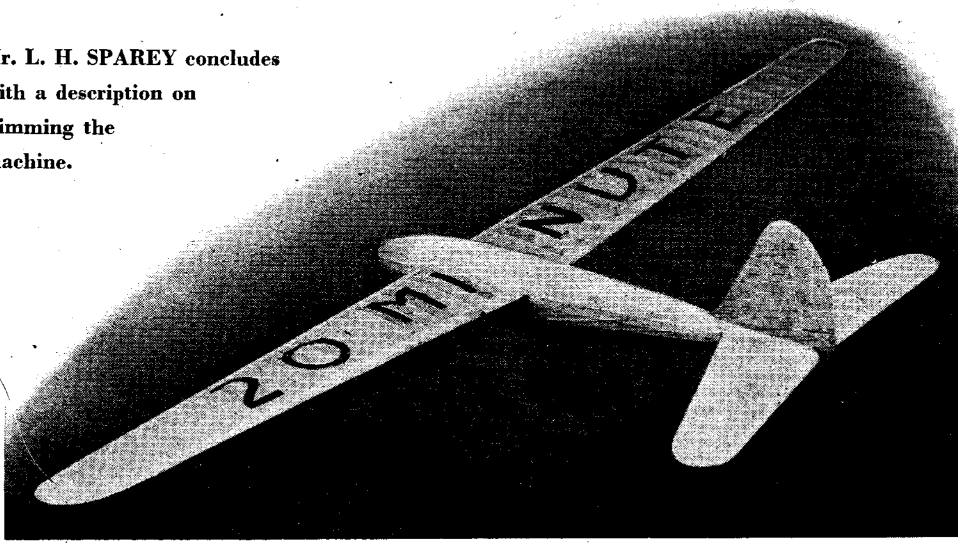
[Since the receipt of the above article from Mr. Phillips, he has recently submitted a further article, along with two excellent photographs, describing the construction of the carburettor. We propose to publish this in an early issue.—Ed. "M.E."]

(To be continued)

★ Model Aeronautics

The Twenty Minute Glider

Mr. L. H. SPAREY concludes with a description on trimming the machine.



Ready for the air.

AS the position of the wings, and the angle which they assume in relation to the fuselage and tail plane, are fixed, there is little trimming to be done on the glider. The line-up has been " built in " to the machine, and there is no provision for any adjustment. Only in one particular is there an exception, namely, in the placing of the centre of gravity. For this purpose it will be remembered that a sliding trimming weight, which may be moved fore and aft along a wire affixed to the noseblock, was provided.

The object to be aimed at is to so place this trimming weight that the nose of the machine will tilt slightly downwards when in the air, thus giving a gliding angle to the machine. Like any other aircraft the glider can only sustain itself by means of a forward movement relative to the air, and this movement, in a glider, is normally provided by the force of gravity, instead of the propeller and motor of the aeroplane. Obviously, the flatter the gliding angle of the machine becomes, the more economically will be expended the power obtained from gravity, always provided that this power is sufficient to maintain the 'plane at the necessary flying speed.

Fortunately, the " Twenty Minute Glider " is a well-tried product, and its characteristics have been so well determined, that trimming has been reduced to a mere rule of thumb procedure, which may be attempted in the workshop. The rule is that the machine should balance when suspended from a point midway across the chord (or width) of the wings. This point may be determined sufficiently well for a trail glide, by measuring to a point halfway along the length of the wings, and from here halfway across the width of the wings. From these points the machine may be balanced by placing the fingers beneath the wings, and adjusting the trimming weight along the wire, until the machine hangs *horizontally*. When the position of the trimming weight has been found, it may be secured in place with a rubber band.

On the field, a trail glide may be attempted by holding the machine above the head, with the nose pointing slightly downwards, and launching it at a point on the ground about twenty yards ahead of you. Launch with a gentle, easy swing, and on no account throw the machine into the air. The glide obtained should be long and flat, with a very " solid " quality of flight ; that is, the machine should have a rock-like steadiness. This solid quality of flight is a characteristic of this glider ; in fact, it almost looks as if one could sit upon it, and enjoy the glide, too.

If the machine shows any tendency to stall, the trimming weight must be moved slightly forward towards the nose ; if, on

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* *Continued from page* 333 " *M.E.,*" *April* 2, 1942.

the other hand, the machine glides too steeply to earth, the trimming weight may be moved backwards. Proceed in this manner until the longest and flattest glide is obtained.

Quite considerable distances may be covered by the glider by this hand launching alone, but for serious work some launching method which will enable the machine to attain height is called for. Several systems are in use; all of them, however, make use of a towline of fine twine. One hundred and fifty feet of light, sea-fishing line makes an ideal towline. To one end is fixed a strong metal ring, about ½ in. in diameter, and this is placed over the hook provided on the bottom of the fuselage. In windy weather

The Yugoslavian glider team at the last "King Peter" Cup Competition. Note the elaborate winch strapped to the chest of the operator. Mr. C. A. Rippon is timing the flight.

the forward hook will be used, but for calm weather, or light winds, the rear hook is used. As you will not, of course, try out your glider in really windy weather, we will assume that the rear hook is in use.

Launching a glider by towline is really the same thing as flying a kite, and those of you who have retained your boyhood memories will require no instruction. For those that have lost this boyhood thrill, the following is the procedure. Pay out about 100 ft. of the line, and get an assistant to walk backwards with the machine until the line is tight. At the moment that your assistant releases the machine, pull gently on the line, hand over hand, so that the glider rises into the air. Although the glider will be attaining height, you will, of course, be shortening your line, so when a reasonable altitude has been reached, and the machine shows no signs of climbing higher, gently pay out the line again. On this, the machine will begin to fall, but may be checked by gently pulling the line towards you, or by walking backwards with the line held. Having now let out a longer length of line, the machine may again be made to soar by pulling in the line a little. The art lies in pulling in less line than you let out, and by gaining height by manoeuvring the head of the glider into the wind. When all the towline is out, and the machine soars overhead, it will overrun the towline, and the ring will drop off the hook. Some skill is required, when slackening the line during the attainment of height, not to release the ring from the hook before its time, but one soon gets the feel of the machine in the air.

It is usual to fix a small silk streamer to the end of the towline, about ten feet from the ring. This serves a double purpose, in so far as it will indicate the direction of the wind, so that you may be certain that you are pulling the machine into it. Very often the wind at the earth's surface is blowing in a different direction from that quite a short distance above, especially when winds are light. The second purpose of the streamer is that it will quickly indicate when the towline is detached from the machine, it being not always possible to see the end of the line itself. The streamer will, really, serve a third purpose, in that it will indicate where the end of the line has dropped upon the ground, thus saving an irksome search in the grass, after following up the line from its source.

In most glider competitions, the above method of launching is specified, except that competitors use a winch. This gives a much better control of the line, and some very elaborate winches are in use, especially among the continental flyers. These flyers mostly use the large gliders of 10 or 11 ft. span, and, in a good wind, these are, believe me, a man's job. In particular do I remember the elaborate winches used by the Yugoslavia team in the last "King Peter" cup competition. These were quite large affairs, with a drum of some 10 in. diameter; geared, with two speeds, and a ratchet clutch. They were strapped to the chest with a harness, and reminded me of nothing so much as the great winches which are strapped to the chest and shoulders for tarpon and other great game fishing. Fortunately, our present glider calls for no such elaborate mechanism, and my own winch is quite a simple, home-made affair.

It consists of a cheap, bench, hand grindstone; the stone has been removed, and is replaced by a wooden drum, 6 in. in diameter with a width of 1 in. Into this drum has been turned a groove ½ in. wide and 2 in. in depth. The whole is clamped to a piece of broom handle, about 18 in. long. It serves its purpose admirably.

Another method of launching the glider is in use, but is not so handy or popular as that detailed above. The system entails the use of a composite towline, made up from 50 ft. of fishing line and 50 ft. of rubber. The rubber should be double; that is, 100 ft. should be doubled upon itself. One end of the rubber is attached to a stake driven into the ground, and is stretched by walking away from the stake for a distance of almost 200 ft. The line is attached to the machine, which is then catapulted into the air. The system is effective, and has the advantage that it may be operated single-handed. It is, however, a little expensive; furthermore, supplies of rubber for model aeronautical work are now very limited, and it would seem to be more "sporty" to leave the small amount of rubber available for the model aeroplanes which cannot function without it.

A third method of launching gliders which I have seen operated, but have not myself tried out, is the following :—

A standard 150 ft. towline is used; this is passed through a pulley fixed to a stake driven into the ground. The line is paid out, and an assistant walks with the machine, away from the stake, until all the line is out. On his releasing the glider, the operator, who has remained by the stake, runs in the direction of the glider, pulling the free end of the line with him. This, of course, causes the glider to soar into the air until maximum altitude is reached, when the towline drops free. It is, naturally, arranged so that the machine is launched into the wind. This system is also quite effective, but, like the catapult method mentioned above, is only permissible when the exact trim of the glider is known.

All these schemes are, of course, only means for getting the glider into the air, and the actual duration of flight does not depend greatly upon them. The real flight of gliders depends upon the lift obtained from thermal air currents and updraughts which are always present in the atmosphere, especially on fine and sunny days. The power of these currents is surprising, and I have seen model gliders and aeroplanes suddenly caught by an air draught, rise into the air as if they were being pulled by a string from above. These are the conditions which delight the heart of the experienced glider enthusiast, and which will, I hope, sometime delight your heart also.

Lubricating Machine Tools

THE proper lubrication for any given machine tool depends upon the duty involved and the method used for applying the lubricant. However, any oil used must meet definite requirements of viscosity, ability to flow at low temperature, and resistance to breakdown in service. Body or viscosity must be sufficient to prevent metal-to-metal contact, but must not be so heavy as to cause high internal friction or to fail to penetrate the close clearance involved. Breakdown resistance must be sufficient to prevent decomposition or gumming under continuous service. It is also important that any oil used be free from impurities which might injure machine parts or oiling mechanism. Acid, for instance, will cause pitting of highly-polished metal surfaces.

But troubles frequently occur which are traceable to the lubricant, method of applying it, or to the mechanical condition of parts of the machine tool. A few of these troubles are given hereunder; each suggests its own remedy.

Troubles Traceable to Lubricant

Lubricant does not have the proper physical characteristics; lubricant is contaminated or emulsified; lubricant been too long in use.

Troubles Traceable to Method of Applying Lubricant

Lubricant not being fed in sufficient quantity; incorrect application of lubricant; oiling devices and supply pipes not clean and choked; imperfect distribution of the lubricating film.

Troubles Traceable to Mechanical Conditions

Change in the load conditions necessitates a change in the lubricant; equipment out of alignment; vibration due to unbalance; bearing material excessively sensitive to temperature variations; insufficient means of proper heat transfer from the bearing.—A. J. T. E.

Letters

Marine Spirit Burners

DEAR SIR,—The kindly efforts of Mr. V. Harrison and "Clyde" to convert me to a "spirits addict" are in vain!

Being mixed up with seafaring, I can assure "Clyde" that the times any real vessel is on a dead even keel fore and aft are rare, the trim being, practically in every case, in varying degrees down by the stern; also, all craft have a tendency to "squat" at speed, and this applies to troubles Mr. Harrison may yet run into, I fear.

All my craft were built with an eye to "reasonably" open waters, and in a lop, believe me, the bird fountain is not reliable, and the whole shooting-match becomes merely an "illicit still"—I have tried it!

In a decked-in boat, heat upsets the entire physical principles of this type of feed, which depends on a pressure below atmospheric on the top of the fluid; now the rate of evaporation rises both with diminished pressure and heat, and so does the volume of vapour so generated, thus creating higher sump levels. Pitching, rolling and vibration all shuffle a few more jokers into the pack.

Hence I maintain that if your boat is tried in the bath and then on a calm pond you may just dodge trouble; but put her in a relatively heavy sea or a collision, and see what happens!! It is just possible that if the sump could be arranged abaft the boiler instead of forr'ard of it, things might be a bit easier; but as everyone knows, this is not a convenient layout in orthodox planning.

Yours faithfully,
"DISGRUNTLED."

Clubs

The Society of Model and Experimental Engineers

There will be a Rummage Sale in the Workshop, 20 Nassau Street, London, W.1, on Saturday, 25th April, 1942. All lots should be entered by 2.30 p.m. Owing to the shortage of small tools and materials there has been some very brisk bidding at recent sales, and it is hoped that members will do their best to exchange any surplus supplies they may have by bringing them to the Workshop on the date mentioned.

Secretary, H. V. STEELE, 14 Ross Road, London, S.E.25.

The Kent Model Engineering Society

At Sportsbank Hall, Sportsbank Street, Catford, on Sunday, April 19th, at 11 a.m., Mr. Wattingham and Mr. Brock will describe the construction of their new locomotives.

On the following Sunday, Messrs. Bernardes, Thorne, Wattingham and Cook will give short talks on how they started Model Engineering.

May 3rd, track run, when it is hoped to have further extensions to present length of available track in operation.

The Secretary will be pleased to forward particulars of the Society.

Hon Secretary, W. R. COOK, 103 Engleheart Road, Catford, S.E.6.

The Glasgow Society of Model Engineers

The last meeting of the Winter session was devoted to "Practical Experiences" and was exceptionally well attended. We were very pleased indeed to welcome back our genial Chairman, Mr. A. J. Brown, who has just recovered from a long and serious illness. A contingent of speedboat experts from Ayr, including Mr. A Rankine and Mr. Latta, contributed materially to the success of the meeting.

Meetings for the Summer session will be announced in due course.

Hon. Sec. Mr. J. SMITH, 785, Dumbarton Road, Glasgow.

The City of Bradford Model Engineers' Society

Future meetings of the above Society are: April 19th, Channing Hall, at 10.30 a.m., Mr. W. D. Hollings will give a lecture on "Pattern-making and Foundry Practice for Model Engineers."

Sunday, May 17th, Channing Hall, at 10.30 a.m., Mr. A. Chubb will give another of his interesting lectures, the subject being "Timekeepers, Ancient and Modern."

Hon. Sec., G. C. ROGERS, 8, Wheatlands Grove, Daisy Hill, Bradford.

The Junior Institution of Engineers

Saturday, 18th April, 1942, at the James Watt Institute, Birmingham, at 2.30 p.m. Midland Section. Special Meeting, Demonstration and Talk, entitled, "Synchrophone as an Aid to War-time Training," by N. Sandor, M.I.Mech.E.

The Annual Luncheon of the Junior Institution of Engineers will be held on Saturday, the 25th April, 1942, at the Holborn Restaurant, High Holborn, W.C.1, at 1 o'clock for 1.30 p.m.

NOTICES.

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written, and should invariably bear the sender's name and address.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co. Ltd., Cordwallis Works, Cordwallis Road, Maidenhead, Berks. Annual Subscription, £1 10s., post free, to all parts of the world.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," Cordwallis Works, Cordwallis Road, Maidenhead, Berks.